Chapter 9

POLLUTION CONTROL MEASURES

Chapter 9 POLLUTION CONTROL MEASURES

9-1 Outline

While providing major benefits to commuters, the RBCS Project may bring about environmental impacts to some extent. This chapter examines possible adverse environmental impacts of the project along the railway corridor and their control measures required in the project.

9-2 Environmental Protection in Malaysia

The Environmental Quality Act of Malaysia regulates activities of manufacturers and business establishments which may cause environmental pollution.

Section 34A of it requires environmental impact assessment for the following railway projects:

(a) Construction of new routes
(b) Construction of branch lines

Thus, in general, neither RBCS Project nor DTP is required such assessment.

Regarding the discharged waste water, however, the workshop and the DMU depot will subject to pollution control regulation pertaining to Section 51 of the Act and its enforcement regulations of 1979 (Sewage and Industrial Effluents).

9-3 Noise Control Measures

9-3-1 Noise

Upon completion of the project, 102 trains (7 cars each) will be operated daily in the year 2005 between Rawang and Seremban with 10-minute headway (in particular, 5-minute headway between Batu Jct. and Port Klang Jct.), and 52 trains between K.L. and Bangi. Naturally this will cause increase in noise to wayside areas.

Generally, train noise is known to be produced by the following sources:

(1) Wheels/rails: Sound of friction and impact generated by wheels rolling on rails, and irregular sound produced by hitting rail joints

(2) Bogie/running gear: Vibration of bogie, and friction between the wheel and the brake shoe

(3) Driving equipment: Rotation of engine and reduction gear

(4) Body: Vibration of body and windows, and impact at couplings

(5) Auxiliary equipment: Rotation of compressor, blower, and auxiliary equipment

(6) Service equipment: Rotation of air-conditioner and shearing sound

Among them, noise from diesel engines and that from friction between wheels and rails are considered to be major sources of noise pollution in the RBCS Project.

9-3-2 Noise from Diesel Engine

Although it is difficult to significantly reduce noise from the diesel engine, steady improvements have been made through the use of double wall construction or steel material around the combustion chamber, and better timing control for fuel

injection.
As for engine noise from idling DMU trains at K.L. station, it is expected to be maintained at the level similar to those produced by currently used diesel locomotives and passenger coaches. Moreover, since the RBCS Project plans to stop DMU trains in the northern part of the K.L. station, where the dome roof does not exist, idling noise will not make a major nuisance to the passengers on the platform.

Regarding engine noise in running, noise levels of a 600 PS and a 350 PS engines measured by an engine manufacturer are summarized as follows. This indicates that noise from the engine is not significant.

Table 9-3-1 Noise Levels of Diesel Engines for DMUs
Measuring point (1.0m from engine)

[dB]

Type of engine	Floor side	Rail side	Front
NTA855	102	102.5	99.5
KTA19	104	103.8	103.8

Note: NTA855 350 PS/2100 rpm
KTA19 600 PS/2100 rpm

MRA is currently operating diesel locomotives model 24 equipped with 2,400 PS engines, which produce larger noise than that by RBCS DMUs. Thus, the noise problem in RBCS Project appears to be its long operating time (from 6:00 a.m. to midnight) and a high frequency of train operation, rather than the noise level.

9-3-3 Noise from contact between wheels and rails

Another major source of noise is contact between wheels and rails, which often accompanies vibration.

(1) Rail

Noise on the rail side is produced from a rail joint and surface. This can be reduced through the use of long rails or the shaving-off the corrugation from rail head.

At the same time, noise from a turnout can be reduced by increasing its weight, whereas the use of ballast road bed is very efficient in reducing vibration.

(2) Wheel

Noise on the wheel side is produced from the flattening of wheel tread caused by quick braking, and deformation of wheel shape due to unusual wearing of the flange.

In particular, the flattened wheel tread produces large noise, reduces riding comfort, and accelerates wear of rails and risk of derailing.

To prevent the flattening of wheel tread, DMUs need to have a function to automatically adjust a braking force when detecting wheel-slip, and due consideration should be given to selecting deceleration performance of the brake. At the same time, under floor wheel lathe capable of turning wheels as mounted on bogie need to be introduced to car depots for quick repairing of the wheel tread.

9-3-4 Noise along the Rail/Road-Side

The whole railway line of the Project has wide right-of-way, ranging from around 20m to more than 40m.

Consequently, the noise is expected to dissipate significantly outside the right-of-way. For instance, 105 dB noise at a source is estimated to be reduced to around 89 dB at 20m away and 86 dB at 40m away from the source.

Note: Equation to estimate noise dissipation with distance

$$SPL_2 = SPL_1 - 12 \, Log_{10} \frac{r_2}{r_1} \quad \text{--- (experimental equation)}$$

r_1, r_2 : (Distance from noise level)
SPL_1, SPL_2 : Noise levels at r_1 and r_2 (dB) (Sound pressure level)

Note: When the source is located at 1.5m above the ground and the distance from the source is measured as a horizontal distance.

r_1 = 1 m
r_2 = 20 m
SPL_1 = 105 dB

$$SPL_2 = 105 - 12 \times Log_{10} \frac{20}{1} = 105 - 12 \times 1.301$$

$$= 105 - 15.162 = \underline{89.84 \text{ (dB)}}$$

Generally, noise pollution is affected by subjective judgement of each person, thus it is difficult to determine tolerable levels acceptable to all people.

As discussed in Section 9-2, environmental impact assessment is not required for RBCS Project. Nevertheless, it is recommended that upon its opening MRA will voluntarily measure noise at various points such as and hospitals where noise pollution may become public concern.

As for road vehicles, Item 5 of the Enforcement Regulations of the Environmental Quality Act (Noise from Motorvehicles) specifies the maximum noise levels in accordance with types of vehicles. Tolerable noise levels for the largest vehicles (maximum weight of more than 3.5 tons and output of more than 200 PS) in category 5 (passenger transport) and category 7 (goods transport) are specified at 85 dB and 88 dB respectively.

In practice, however, some vehicles produce larger noise due to the insufficient maintenance.

Engine of a DMU and a motor vehicle will produce noise more or less at the same level. In terms of overall environmental impacts, however, the railway will bring less adverse effect on its wayside area than highway, because railway tracks runs in the wide right-of-way zone.

Furthermore, since the passenger carrying capacity of a train is far larger than that of road vehicle, if DMU passengers should have to be transported by road vehicles, road traffic will increase considerably, aggravating traffic congestion and further aggravating roadside environment.

9-4 Air Pollution Control Measures

9-4-1 Types of Air Pollutants

Exhaust gas from diesel engines of DMUs contains air pollutants, such as NOx, SOx, CO, and HC, and in particular NOx is most easily produced due to high temperature/high pressure combustion.

SOx can be reduced significantly by using low sulfur fuel, as practiced in advanced countries.

On the other hand, as NOx is produced from nitrogen in the air it cannot be reduced by improving quality of fuel.

Thus reduction of total exhaust gas from diesel engines is required to reduce NOx.

Today, 70% to 80% of NOx generated in large cities of the world are said to come from motor vehicles. NOx and HC further produce oxidant through photochemical reaction with ultra-violet rays in the sunlight, which causes extensive secondary pollution, such as photochemical smog or acid rain.

In Japan, acceptable levels of NOx in the air, as part of ambient air quality standards, vary with areas between 0.04 ppm - 0.06 ppm. On the other hand, no law and standard is established in Malaysia.

In Malaysia, law and standard to regulate exhaust gas from user's motor vehicle and other engines has not established. Manufacturing plants, however, are required to measure smog concentration in engine exhaust gas by the Ringlemann chart method.

9-4-2 Air Pollution Control Measures

Since rail transport achieves higher efficiency per unit of energy than buses and other road modes, and assuming that a considerable portion of commuters of road modes will divert to RBCS, the fuel consumption in the Klang Valley area is expected to decrease accordingly.

To estimate and compare the amounts of exhaust gas from DMUs and stage buses is very difficult on account of different operating conditions, thus annual fuel consumption is used as a surrogate.

To estimate the saving in annual fuel consumption by implementating the RBCS Project, the increase in fuel consumption of DMUs, and the decrease in fuel consumption of stage and feeder buses in 2005 are estimated. Then the two figures are subtracted as shown in Table 9-4-1.

Table 9-4-1 Estimated Reduction in Exhaust Gas (in 2005)

Category	Saving in annual fuel consumption (liter/year)	Saving in annual exhaust gas (Nm^3)
Diesel railcars	$- 8.65 \times 10^6$	$- 1.14 \times 10^8$
Stage and feeder buses	10.71×10^6	1.41×10^8
Total	2.06×10^6	0.27×10^8

As shown in Table 9-4-1, fuel saving at an annual rate of 2.06×10^6 liters can be achieved in the year 2005 under the RBCS Project, thus the corresponding amount of exhaust gas will be reduced in the Klang Valley area.

Based on the data given in Table 9-4-1, the annual saving in exhaust gas from DMUs of BRCS Project is estimated at -1.14×10^8 Nm^3 in 2005. (See Appendix 9-4-1)

Assuming that DMUs and stage/feeder buses use engines which produce the same amount of air pollutants, the total amount of reduced exhaust gas in Klang Valley is estimated to be <u>0.27×10^8 Nm^3</u> per year.

It should be noted, however, that the amount and concentration of air contaminants, such as NOx, vary greatly with running modes, thus not necessarily proportional to the amount of exhaust gas.

For example, buses and diesel automobiles which do not undergo sufficient engine tuning will exhaust larger amount of contaminants due to frequent starting and stopping.

Hence, it can be safely assumed that air contaminants can be reduced by the amount exceeding above estimation.

9-5 Water Contamination Control Measures

9-5-1 Waste Water from Workshops and DMU Depots

In Malaysia, DMU depots and workshop are required to maintain contamination levels of waste water below legally required standards.

Facilities subject to such regulation are those discharging waste water at a rate of 60 m^3 or higher daily, pertaining to the provisions of Paragraph 4, Item 3 of the Enforcement Regulations of the Environmental Quality Act of 1978 (Sewage and Industrial Effluent), and two types of limited values (A and B) are specified according to river systems to which waste water is discharged.

Note that type A denotes river systems along which a water intake for tap water for local residents is provided, thus more strict waste water control is required.

It appears that DMU depots in Rawang and Seremban as well as Sentul Workshop are located within the type B area.

As for DMU depots, while an amount of waste water from the fuel feeder facilities is not likely to reach the legal discharge level, but if waste water from car body cleaning and other works is added, a daily discharge may exceed 60 m^3/day.

Among various indicators of polluted water, oil is considered to be the most detrimental, because it will cause a serious damage to crops.

9-5-2 Water Treatment Facilities

Most of oil flow-out at the DMU depot occurs in the process of maintenance work and refueling. In the latter case, when the refueling operation is carried out in a wide area, oil is mixed with rain water, thus requires a treatment facility of relatively large capacity.

Therefore, it is desirable to restrict the refueling operations to a limited area.

The RBCS Project plans to provide waste water treatment facilities at Rawang and Seremban DMU depots, with capacities suitable for their refueling facilities. Also, a large treatment facilities will be provided at Sentul Workshop for waste water for cleaning of parts.

Note that, since DMUs with stainless steel body will be introduced under the RBCS Project, automatic car washing machine by use of water will be installed at the Bangi DMU depot and that capable of detergent washing at the K.L. DMU depot. At the same time, special devices to remove COD or to adjust PH value will not be provided unless specifically required.

Generally speaking, waste water from rolling stock workshops and DMU depots rarely contain heavy metals and other detrimental substances, excepting such special substances as PCB (poly-chloro-biphenyl).

Results of waste water treatment carried out by JR Group are summarized in Appendix 9-5-1. Note that the flotating-air separating treatment system shows high efficiency in removing waste water of high oil content at an economical cost.

The capacities of the waste water treatment facilities are calculated as described in 7-4-2 (3); those at Rawang and Seremban DMU depots are estimated at 1.0 ton/h each, and that at Sentul Workshop at 10.0 tons/h.

Chapter 10

IMPLEMENTATION PLAN

Chapter 10 IMPLEMENTATION PLAN

10-1 Investment

10-1-1 Premises

(1) Based on the acquired data on materials, wages, etc. in Malaysia and procurement/construction costs of the similar projects in Asian countries, the investment cost is estimated.

(2) The estimated cost is as of September, 1990, and no escalation element is taken into account.

(3) The foreign exchange rate is set at 1M$ = ¥51.5.

(4) Costs of imported equipment and materials are composed of CIF price, custom duty and salev tax.

(5) Market price is adopted for locally procured equipment and materials.

(6) Wages for all construction works is estimated in local currency.

(7) The all investment costs except for DMUs and feeder-suses includes 5% of contingency costs.

10-1-2 Investment Cost

Investment costs for RBCS Project is summarized in Table 10-1-1. Related governmental expenses required for the RBCS Project is shown in Table 10-1-2.

Table 10-1-1 Investment Cost for RBCS Project

(million M$)

Item	Classification	Total	Local Currency: Personnel expenses	Local Currency: Other Expenses	Foreign Currency
Track and Structure	Track	10.30	2.83	4.76	2.70
	Roadbed	1.12	0.38	0.74	–
	Bridge (Road & Passenger)	8.55	1.89	6.36	0.30
	Platform	5.93	1.53	4.40	–
	Building	24.94	5.99	18.77	0.18
	Sub Total	50.84	12.63	35.03	3.18
Machinery and Equipment	Escalator	5.50	0.11	0.16	5.23
	Vending Machine	5.16	0.09	0.77	4.30
	Air Conditioner at KL	1.34	0.14	0.34	0.86
	DMU Maintenance Plant & Machinary	19.30	0.99	3.80	14.51
	Sub Total	31.30	1.33	5.07	24.90
Signalling and Tele-communi-cation	Signalling Equipment	20.48	3.55	4.66	12.27
	Track Circuit	19.59	1.26	4.72	13.61
	Radio Equipment	3.73	0.09	0.73	2.91
	Telecommunication Equipment	14.25	2.18	2.25	9.82
	Cable	3.65	1.00	2.26	0.39
	Sub Total	61.70	8.08	14.62	39.00
Engineering and Consultant		7.19	–	–	7.19
Total for Ground Facilities(A)		151.03	22.04	54.72	74.27
DMU (B)		377.32	–	49.22	328.10
Railway (C)=(A)+(B)		528.35	22.04	103.94	402.37
Feeder Bus (D)		87.33	–	30.75	56.58
Grand Total (E)=(C)+(D)		615.68	–	186.73	458.95

1) Prices as of Sept 1990 are used.
2) Exchange rate between M$ and Yen being set at 1 M$=51.5 Yen.
3) Investment cost for ground facilities includes contingency set at 5% of construction cost.

10-1-3 Implementation/Investment Schedule

Implementation schedule of the RBCS Project and its investment schedule is shown in Table 10-1-3 and Table 10-1-4.

Table 10-1-2 Governmental Expenses Required for the RBCS Project

(million M$)

Infrastructure Free Passageway Station Plaza Feeder Bus	 3.78 12.20 34.00
Maintenance Plant & Machinery for DMU introduced by DTP	4.59
Total	54.57

Table 10-1-3 Implementation/Investment Schedule

(million M$)

	Year	1992	93	94	95	96	97	98	99	2000	01	02	03	04	05
Railway			▽ Inauguration of DTP				▼ Inauguration of RBCS								
	Designing		■	■											
	Track & structure				■	■		■			■			■	
	Building				■	■		■			■			■	
	Machinery & Equipment				■	■			■		■			■	
	Signalling & Telecommunication				■	■									
	DMU					■				■				■	
	Invest. total	—	3.60	3.59	47.13	306.66	—	3.69	16.83	49.17	2.79	—	—	94.89	—
	(Foreign Currency)	—	(3.60)	(3.59)	(20.48)	(236.41)	—	(0.18)	(12.96)	(42.76)	(0.87)	—	—	(81.52)	—
Feeder bus	Implementation						■	■	■	■	■	■	■	■	■
	Invest. total	—	—	—	—	—	60.55	3.39	3.39	3.39	3.39	3.39	3.32	3.32	3.19
	(Foreign Currency)	—	—	—	—	—	(40.01)	(2.10)	(2.10)	(2.10)	(2.10)	(2.10)	(2.05)	(2.05)	(1.97)

Table 10-1-4 Initial/Additional Investment Plan

(million M$)

		Initial ('93-'97)			Additional ('98-'05)			Total		
		Total	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C
Rail	Track & structure	25.11	22.11	3.00	1.30	1.30	0	26.41	23.41	3.00
	Building	19.19	19.19	0	5.24	5.06	0.18	24.43	24.25	0.18
	Machinery & Equipment	12.52	2.21	10.31	18.78	4.19	14.59	31.30	6.40	24.90
	Signalling & Tele-communication	61.70	22.70	39.00	0	0	0	61.70	22.70	39.00
	DMU	235.27	30.69	204.58	142.05	18.53	123.52	377.32	49.22	328.10
	Engineering	7.19	0	7.19				7.19	0	7.19
	Sub total	360.98	96.90	264.08	167.37	29.08	138.29	528.35	125.98	402.37
Feeder bus		60.55	20.54	40.01	26.78	10.21	16.57	87.33	30.75	56.58
Grand total		421.53	117.44	304.09	194.15	39.29	154.86	615.68	156.73	458.98

L/C=local currency
F/C=foreign currency

Chapter 11

ECONOMIC ANALYSIS

Chapter 11 ECONOMIC ANALYSIS

This chapter intends to evaluate the economic feasibility of the RBCS Project(Rawang~Seremban) from the viewpoint of the national economy.

11-1 General

The economic feasibility of a project is usually assessed by the difference between the Case-with-the-Project and Case-without-the-Project, of the value aggregated throughout the project life, of the economic benefits minus economic costs which arise from the implementation of the project. There, the "benefits" are represented by the time and resources, etc. saved by the implementation of the project. While, the "costs" are represented by the costs of investment and operating/maintenance the facilities, etc. arising from the implementation of the project. There, such benefits and costs as will be only transferred from a person to another in the same national economy are not counted. ("Duties", "Taxes" are the examples.)

11-1-1 Identification of Economic Benefits and Costs

In this study, as the economic benefits, the following values were counted. Namely; the commuters' time (RBCS commuters as well as road vehicle using commuters) which would be saved, and the value of road-vehicle-related costs which would be saved, each through implementing this project. As the economic costs, the costs of constructing and operating/maintenance the MRA Rawang~Seremban Corridor and its feeder-bus system were counted. Other benefits and costs, such as those environmental improvement, job creation, etc. were not counted, since their quantification was considered tend to be capricious.

11-1-2 Definition of Case-with-the-Project and Case-without-the-Project

The Case-with-the-Project is the case where all the Integrated RBCS networks are implemented, operated as pre-conditioned in this study. The Case-without-the-Project is the case where the Integrated RBCS networks are implemented and operated, except the MRA Rawang~Seremban Corridor and its attendant feeder-bus system. The railway service level in Rawang-Seremban Corridor is assumed to stay at that of 1993 when the DTP is completed. In both cases, the road networks and other portions of the Integrated RBCS network were assumed to be completed as planned.

11-1-3 Economic Internal Rate of Return (EIRR)

The benefits and costs thus identified, they are compared between the two cases with-and without-the-project defined as above. The difference will tell whether the project will bring forth economical gain or loss to the national economy. If the gain is higher than in comparable projects, this project can be considered as economically feasible. The said difference is assessed by a discount rate; EIRR. It is computed by the formula given below:

$$0=\sum_{i=1}^{n} Ai / (1+EIRR)^{i-1}$$

where, n : Project life (30 years 1993~2022)

Ai : Difference of investment and operating /maintenance With-the-Project and Without-the-Project, plus the benefit arising from implementation of the Project.

In calculating the above-mentioned "Ai", the following rules were observed in accordance with the normal practices of EIRR calculation:

(1) Economic prices:

In estimating the investment cost and operating/maintenance costs, all the governmental impositions were deducted from the market prices; "Taxes", "Duties" or under any other names, since they are the costs to be transferred from the project to the government. In this context, the deduction was made applying to the market prices, the conversion rates authorized by EPU given in Table 11-1-1. When the materials are imported, the CIF prices were considered as the economic prices. No inflation was considered.

Table 11-1-1 Conversion Factors for Economic Price

Work Item	Rate
<u>Road Transport</u>	
a) Road Construction	0.82
b) Road Maintenance	0.86
<u>Rail Transport</u>	
a) Rail Construction	0.85
b) Track Maintenance	0.84
c) Rolling Stock Maintenance	0.85
d) Rail Operation (including Direct Operating Cost Administrative & Other Cost)	0.80

Data National Parameters for Project Appraisal in Malaysia (EPU 1986)

(2) Reinvestment

The same amount of initial investment of depreciable assets is reinvested in the year following the expiration of its useful life.

(3) Residual Value

The unamortized portion of depreciable assets, as residual value, will be counted as negative investment in the final year of the project life.

(4) Foreign Currency Exchange Rate

The rate of exchange for foreign currency required for their analysis will be assumed as the rate for September 1990.

M$ 1 = ¥51.5

11-2 Economic Cost and Benefit

11-2-1 Calculation of Economic Cost

(1) Investment cost;

The economic prices of the construction costs estimated in Chapters 8 and 9 were counted. Namely, as for railway, the civil works, signalling/tele-communication, rolling stock and the workshop. As for feeder bus, purchasing/construction costs of buses, the feeder roads, bus-stands.

(2) Operating cost;

The economic prices of the operation cost estimated in Chapter 12 were counted.

(3) Maintenance cost;

The economic prices of the maintenance cost estimated in Chapters 8 and 9 were counted.

As to the maintenance costs which are not estimated in Chapter 12, refer to Chapter 8. The data of MRA, City Hall and Bus Company were applied. Refer to Table 11-2-1.

(4) Residual value;

As to the useful life of the assets, the values given in Table 11-2-1 were adopted.

Table 11-2-1 Useful Life and Maintenance Ratio

Work Item	Useful Life (year)	Maintenance Rates (%)
1. Civil and Station		
Building	50	3.1
Platform	50	3.1
Bridge	100	3.1
Track & Roadbed	60	3.1
Equipment	10	5.0
Escalator	20	5.0
2. Signalling & Telecommunication System		
Signalling	33	5.54
Track Circuit	10	5.54
Ratio Communication	25	5.54
Telecom Facilities	33	5.54
Cable	33	5.54
3. Rolling Stock & Work Shop		
Rolling Stock	25	5.62
Machinery for Depot	20	5.0
Machinery for Workshop	20	5.0
West Water Treatment Facilities	30	5.0
4. Feeder		
Large Bus	12	-
Mini Bus	6	-

Information: 1. Data obtained in MRA, City Hall and Bus Comapny.
2. Maintenance cost is calculated by multiplying the maintenance rate with the initial investment cost.

11-2-2 Calculation of Economic Benefit

(1) Time Saving Benefit

1) Users for railways, stage bus, motorcycles and sedans

a. For the RBCS users (railway, feeder-bus):

The travel-time will be saved for the RBCS users by the improved speed of the service.

b. For the road users (stage-bus, motorcycle and sedan);

The travel-time will be saved for the road users due to the alleviated road congestion.

In calculating the above mentioned benefits, the study resuls by mode of JICA M/P 87 was adjusted to the present value. As to the saved-time and the unit-time-value, refer to Appendix 11-2-1.

Time saving benefit was calculated by the following formula:

$$TB = \Sigma_k \Sigma_i \Sigma_j P_{ijk} (\overline{t_{ijk}^{wo}} - \overline{t_{ijk}^{w}}) V_k$$

where:

TB	:	Time Saving Benefit
Pijk	:	Number of passengers by K mode between zone i and j
$\overline{t_{ijk}^{w}}$	:	Travel time by K mode between zone i and j in case of with-the-project
$\overline{t_{ijk}^{wo}}$	:	Travel time by K mode between zone i and j in case of without-the-period
Vk	:	Time value of person using mode K (constant)
Mode : K	:	Rail, Stage-bus, Motorcycle and Sedan

As to the calculation results; TB, $\Sigma t_{ijk}{}^{wo}$, $\Sigma t_{ijk}{}^{w}$, refer to Tables 11-2-2 and 11-2-3.

Table 11-2-2 Time Saving for RBCS User (TB)

	1997			2005		
	WT	WO	WO-WT	WT	WO	WO-WT
Passenger Hour (1000 hr/day)	551	266	-285	848	543	-305
Time Value (M$/hr)	1.17	1.17	-	1.17	1.17	-
Time Saving (1000 M$/day)	645	311	-334	992	635	-357

Note: WT: Case-with-the-Project
WO: Case-without-the-Project

Table 11-2-3 Time Saving for Vehicle User (TB)

Unit: 1000 M$/day

	Time Value	With Case		Without Case	
	(M$/Vehicle)	Vehicle* hr (1000 Vol* hr)	Time Saving (1000 M$)	Vehicle* hr (1000 Vol* hr)	Time Saving (1000 M$)
1. in 1997					
Motorcycle	1.40	586	820	592	829
Sedan	4.98	1206	6006	1217	6061
Bus	34.99	45	1575	53	1854
Total	-	-	8401	-	8744
2. in 2005					
Motorcycle	1.40	805	1127	813	1138
Sedan	4.98	1756	8745	1773	8830
Bus	34.99	66	2309	75	2624
Total	-	-	12181	-	12592

2) Saving in access/egress time required for stage bus users;

Besides, another factor must be considered; The travel-time of RBCS users include, in calculation, the time from the centroid to railway station. While, that of stage-bus users excludes the time from centroid to the nearest road node. This should be counted as a benefit of RBCS. Based on the interview survey, the average access/egress time from the centroid to the nearest road node was assessed as 0.3 hours.

Table 11-2-4 Time Value for Access and Egress Means (TB)

Unit: 1000 M$/day

	1997			2005		
	WT	WO	WO-WT	WT	WO	WO-WT
RBCS User (1000 Passengers)	91	429	-	91	598	-
Incremental Stage Bus User (1000 Passenger)	-	-	338	-	-	507
Time (hour)	0.3	0.3	-	0.3	0.3	-
Time Value (M$/hr)	1.17	1.17	-	1.17	1.17	-
Total	31.9	150.6	118.6	31.9	209.9	178.0

(2) Saving in vehicle operating cost

1) Vehicles for Stage-bus, sedan, motorcycle and truck;

When the traffic is diverted to railway, it will result in a relative decrease in number of stage bus (a decrease in fixed cost of road vehicles). Then, the vehicle operating cost will decrease, too, due to the alleviation of road congestion (a decrease in running cost of road vehicles). These unit price of fixed cost and running cost are given in Appendix 11-2-2. The vehicle running costs by speed is given in Appendix 11-

2-3. The reduction in the vehicle operating costs was calculated by the formula below:

$$VB = \Sigma_k \Sigma_i \Sigma_j (\overline{RC_{ijk}^{wo}} - \overline{RC_{ijk}^{w}}) + (\overline{t_{ijk}^{wo}} - \overline{t_{ijk}^{w}}) FC_{ijk}$$

where:

VB:	Saving in vehicle operating cost
RC_{ijk}^{wo}:	Running cost of mode k between zones i and j in Case-without-the Project;
RC_{ijk}^{w}:	Running cost of mode k between zones i and j in Case-with-the Project;
t_{ijk}^{wo}:	Travel-time by mode k between zones i and j in Case-without-the-Project;
t_{ijk}^{w}:	Travel-time by mode k between zones i and j in Case-with-the-Project
FC_{ijk}:	Fixed cost of mode k between zones i and j
Mode K:	Stage-bus, Sedan, Motorcycle, Truck

As to the calculated results; RC_{ijk}, RC_{ijk} and FC_{ijk}, refer to Tables 11-2-5 and 11-2-6.

Table 11-2-5 Vehicle Running Cost (RC_{ijk})

Unit: 1000M$/day

	1997		2005	
	With	Without	With	Without
Motorcycle	673	674	898	902
Sedan	4745	4753	6713	6732
Truck	10308	10345	14188	14138
Bus	593	696	860	971
Total	16303	16485	22609	22793

Table 11-2-6 Vehicle Fixed Cost (FC_{ijk})

	Time Value (M$/Vehicle)	With Case: Vehicle* hr (1000 Vol* hr)	With Case: Fixed Cost (1000 M$)	Without Case: Vehicle* hr (1000 Vol* hr)	Without Case: Fixed Cost (1000 M$)
1. in 1997					
Motorcycle	0.53	586	311	592	314
Sedan	1.74	1206	2098	1217	2118
Bus	12.14	45	546	53	643
Truck	2.87	577	1657	597	1715
Total	-	-	4612	-	4789
2. in 2005					
Motorcycle	0.53	805	427	813	431
Sedan	1.74	1756	3055	1773	3085
Bus	12.14	66	801	75	910
Truck	2.87	803	2306	798	2292
Total	-	-	6589	-	6718

2) Saving in feeder bus expenses for stage bus users;

Besides, another factor must be considered; All the feeder bus costs were counted as the cost of the Case-with-the-Project. While, stage-bus users need the feeder-bus, too. In the Case-without-the-Project, where stage-bus utilization must be reinforced, the feeder-bus service cost linking the centroid and the stage-bus terminal would increase. Consequently, this feeder-bus service cost can be deducted from the cost of Case-with-the-Project, or added to its benefit. In estimating this benefit, the feeder bus usage ratio each of the railway and stage-bus commuters was used. Namely, based on the interview survey, the feeder-bus usage ratio was planned in the study at 85% in 1997, 87% in 2005 of the railway commuters, while, it was assumed as 44% of the stage-bus commuters from the results of the interview survey. The difference in weight of the ratios was assessed as 100:50.

Consequently, 50% of the feeder-bus cost saving was counted as the benefit of the Case-with-the-Project, in terms of vehicle operating cost.

(3) Arrangement;

"Ai" of the aforementioned formula being the difference compared between the Case-with-the-Project and Case-without-the-Project, the cost of the Case-without-the Project can be counted as the benefit of the Case-with-Project, and vice versa. When this arrangement is made in the above-mentioned calculations, the benefits of the Case-with-the-Project can be listed as in Table 11-2-7.

Table 11-2-7 Beneficiaries and Their Benefits

Beneficiaries	Benefits
1. Users	
a) Sedan Users	• Saving on Time Cost
b) Motor Cycle Users	• Saving on Time Cost
c) Bus Users	• Saving on Time Cost
d) Railway Users	• Saving on Time Cost
e) Feeder Bus Users	• Saving on Time Cost
2. Vehicles	
a) Sedan	• Saving on Running Cost • Saving on Fixed Cost
b) Motor Cycle	• Saving on Running Cost • Saving on Fixed Cost
c) Bus	• Saving on Running Cost • Saving on Fixed Cost • Saving on Driver Cost
d) Van/pick-up/Lorry	• Saving on Running Cost • Saving on Fixed Cost • Saving on Driver Cost
e) Feeder Bus	• Saving on Running Cost • Saving on Fixed Cost • Saving on Driver Cost

11-3 Calculation Result

The benefit and cost rates (B/C) and the net present value (NPV) have been calculated, discounted by 12% given as an opportunity cost. The result of cash flow analysis is shown in Appendix 11-3-1.

Arrangement of benefit and cost thus made, the EIRR of the base case was calculated to be 28.81%, a fairly good figure of a project of this kind. (Refer to Table 11-4-1.)

11-4 Sensitivity Analysis

In order to be pessimistic in assessing the economic feasibility of the Project, a sensitivity analysis was conducted, under-estimating the benefit and over-estimating the cost compared with the base case, each by ±10% and ±20%, under the conditions otherwise the same with the base case.

Diverted traffic from road to rail forecasted in this Study is restricted to those of public mode; i.e. from stage-bus to railway.

In addition to the above, in fact, a considerable traffic, diverting from private car to rail, is conceivable in view of deteriorating road traffic and upgraded RBCS in the future. Hence, the impact of diverted traffic from private car was also assessed in the form of sensitivity analysis.

Three cases were assumed; 1) case where 20% of stage-bus users shift to the RBCS mode, 2) case where 20% of the sedan - users shift to the RBCS mode and 3) case where 10% of the stage-bus users and 10% of sedan-users shift to the RBCS mode (in each case RBCS cost being increased to accept them accordingly.) The results of the analyses are shown in Table 11-4-1.

Table 11-4-1 Result of the Economic Analysis

	IRR (%)	B/C	NPV ($x10^3$M$)
Base Case	28.81	1.55	382,657
10% Cost up	25.22	1.43	326,960
20% Cost up	22.17	1.33	271,263
10% Benefit down	24.85	1.42	288,694
20% Benefit down	20.81	1.28	194,732
10% Cost up, 10% benefit down	21.55	1.31	232,997
20% Ridership from bus	32.50	1.68	535,397
20% Ridership from Sedan	65.14	3.08	1,634,419
10% from Bus, 10% from Sedan	48.02	2.31	1,027,703

Note : EIRR of the Case "20% ridership increase" above was estimated considering the following benefits and costs:

Benefits: 20% increase in time-saving benefit, in terms of passenger-hours of the railway users and vehicle user.
20% decrease in vehicle operating cost, in terms of vehicle-km and vehicle-hours of buses and/or sedans, equivalent, in capacity, to the number of railway users.
20% decrease in feeder-bus cost linking with stage-bus terminal, in terms of vehicle operating cost.

Costs : 20% increase in DMU purchase and costs for operating/maintenance.
20% increase in feeder-bus costs including operating/maintenance cost.

Chapter 12

FINANCIAL ANALYSIS

Chapter 12 FINANCIAL ANALYSIS

12-1 Objective and Method of Financial Analysis

12-1-1 Objective:

The objective of the financial analysis is to analyze and evaluate the profitability of the RBCS project and the cash flow as the result of its implementation, from the viewpoint of an entity which runs the RBCS (railway and feeder-bus).

12-1-2 Method of Financial Analysis

The Financial Internal Rate of Return (FIRR) is calculated as an index for evaluating the profitability of the project. The FIRR is the discount rate which would make aggregate total of the net present value of cash flow for each year of the project life become zero. It is expressed by the following equation:

$$0 = \sum_{i=1}^{n} Ai/(1+FIRR)^{i-1}$$

where: n: Project life (30 years, 1993-2022)
Ai: Cash flow (see 12-3)

One fund raising plan is assumed and net cash flow for each year of the project life is calculated. Net cash flow is analyzed and the debt repayment ability and the soundness of the fund raising plan is evaluated. Sensitivity analysis is conducted in the case of revenue reduction, cost overrun and increment of ridership.

12-1-3 Premises for Calculation

(1) FIRR calculation of the Railway Service and Feeder Bus Service was conducted with the pre-supposition that MRA would run the both services as an entity placed under the same conditions as a private company as of 1993 and throughout the project life.

(2) Market price

The prices of the materials, equipment, commodities and man-power to be used in this project are as of September 1990 and determined as follows:

--- When locally procured
Market price is adopted.

--- When imported
CIP price plus custom duty and sales tax.

Each duty and tax are based on the Practical Guide to Customs Duties Order published by MDC Sdn Bhd.

Since different tax rates are applied to different kinds of goods, the tax rate calculated with the weighted average is 14.54%.

(Unit: M$ in thousand)

$$\frac{57{,}486 \text{ (Total of custom duty and sales tax)}}{395{,}196 \text{ (Total of CIF price)}} = 14.54\%$$

In cases of bus and mini bus, import currency portion of market price is 62 % and 71 % respectively.

(3) Foreign exchange rate, inflation.

As to these, the same premises as in the economic analysis are assumed.

(4) Project life, etc.

As for the project life, reinvestment, useful life, maintenance rate and residual value, the premises are the same as in the economic analysis.

12-2 Project for Analysis

Analysis is made for the following cases.

Case 1) Financial analysis of Railway Service.

Case 2) Financial Analysis of Feeder Bus Service.

Case 3) Financial Analysis of Railway and Feeder Bus Services.

12-3 Cost Elements in Cash Flow Calculation

This paragraph deals with cost elements in the calculation of cash flows, which is the primary aims of the financial analysis.

Note 1) Cash flow is the amount which remains disposable in the hand of the entrepreneur after he has made investment without relying on borrowing.

Cash Flow = Operating profit + Depreciation cost - Investment cost

where Operating profit = Operating revenue - Operating expense

where Operating expense = Maintenance cost + Personnel cost + Fuel cost + Depreciation cost

2) Net cash flow is the cash amount which remains in the hand of the entrepreneur after he has made initial investment relying on borrowing.

Net cash flow = Cash flow + Borrowing - Repayment - Interest

12-3-1 Investment Cost

(1) Investment cost of the project

The estimated investment cost of Railway and Feeder Bus Services are shown in Table 12-3-1 and Table 12-3-2 respectively.

Table 12-3-1 Estimated Investment Cost of Railway Service

(Unit: M$ in thousand)

Work \ Currency	Local	Foreign	Total
Civil Work	49,266	13,570	62,836
Signalling & Telecommunication	22,702	39,000	61,702
Rolling Stock	49,216	328,106	377,322
Machinery at Depot	3,862	12,963	16,825
Machinery at Workshop	920	1,557	2,477
Engineering & Consultant		7,192	7,192
Total	125,966	402,388	528,354

Table 12-3-2 Estimated Investment Cost of Feeder Bus Service

(Unit: M$ in thousand)

Bus Category \ Currency	Local	Foreign	Total
Bus	22,550	36,080	58,630
Mini Bus	8,200	20,500	28,700
Total	30,750	56,580	87,330

(2) Interest and repayment

The amount of interest payment and repayment are assumed to be subject to the following fund raising plan.

(3) Fund raising plan

This financial analysis is conducted with the pre-supposition that MRA would be an entity placed under the same conditions as a private company.

Government loan and Government to Government borrowing are not considered as a fund raising plan.

Interest rates of international financial institutions are higher than 8% per annum which is interest rate of commercial bank in Malaysia as of September, 1990.

Terms and conditions of commercial bank in Malaysia according to MRA are as shown in Table 12-3-3.

Table 12-3-3 Terms and conditions of commercial bank in Malaysia

Interest rate % p.a.	Term (years)	Grace (Years)	Repayment
8	10	3	Annual

As the result of discussion with MRA, in this analysis, it was assumed that all portion of investment cost (excluding reinvestment) would be financed by commercial bank in Malaysia.

12-3-2 Operating Expense

The operating expense is calculated based on "maintenance cost," "personnel cost" "fuel cost" and "depreciation cost."

(1) Maintenance cost

1) Railway service

It is calculated applying the maintenance rate given in Table 12-3-4 to the incremental assets in the project.

Table 12-3-4 Maintenance Rate

Department	Maintenance rate
Civil Work	3.10% p.a.
Signalling & Telecommunication	5.54% p.a.
Rolling stock	5.62% p.a.
Machinery	5.00% p.a.

Source: MRA data

2) Feeder bus service
It is calculated applying the unit cost per vehicle-km shown in Table 12-3-5. to the incremental vehicle-km.

Table 12-3-5 Maintenance cost per vehicle-km

(Unit: M$)

Category	Maintenance cost per vehicle-km
Bus	0.18
Mini bus	0.09

Source: Bus company, Atur.

Incremental vehicle-km based on demand forecast is shown in Table 12-3-6.

Table 12-3-6 Vehicle-km

(Unit: vehicle-km in thousand)

Year / Category	1997	2001	2005
Bus	12,877	17,580	22,282
Mini bus	21,542	22,773	24,003
Total	34,419	40,353	46,285

(2) Personnel cost

1) Railway service

It is calculated applying the average annual wage of employee for each job shown in Table 12-3-7 to incremental employees.

Table 12-3-7 Average Annual Wage

(Unit: M$)

Job	Annual wage
Driver	11,704
Conductor	9,445
Station master	12,064
Ticket clerk	8,997
Ticket checker	6,654

Source: MRA data

Incremental employees for each job are calculated based on transport plan in Chapter 5, and shown in Table 12-3-8.

Table 12-3-8 Employee

(Unit: person)

Job	1997	2005
Driver	34	38
Conductor	34	38
Station master	27	31
Ticket clerk	59	74
Ticket checker	78	93
Total	232	274

2) Feeder bus service

It is calculated applying the annual wage per vehicle shown in Table 13-3-9 to the incremental number of vehicles.

Table 12-3-9 Annual Wage per Vehicle

(Unit: M$)

Category	Annual wage per vehicle
Bus	41,000
Mini bus	34,000

Source: Bus Company, Atur.

Incremental number of vehicles are shown in Table 12-3-10.

Table 12-3-10 Number of Vehicles

(Unit: vehicle)

Category	1997	2005
Bus	252	451
Mini bus	397	410
Total	649	861

(3) Fuel cost

1) Railway Service

It is calculated based on the rolling stock plan of Chapter 6 and shown in Table 12-3-11 (See section 6-6 in which the method of calculation is mentioned.)

Table 12-3-11 Fuel Cost

(Unit: M$ in thousand)

	1997	2001	2005
Fuel cost	2,605	3,079	5,190

2) Feeder bus service

It is calculated applying the unit cost per vehicle-km shown in Table 12-3-12 to the incremental vehicle-km.

Table 12-3-12 Fuel Cost per Vehicle-km

(Unit: M$)

Category	Fuel cost per vehicle-km
Bus	0.14
Mini bus	0.07

Source: Bus Company, Atur.

(4) Depreciation cost

As to the depreciation cost, the straight line depreciation method is applied, useful life being assumed as the same as in economic analysis (see Table 11-2-1).

(5) Result

1) Railway service

Table 12-3-13 Operating Expense

(Unit: M$ in thousand)

Item	1997	2001	2005
Maintenance cost	18,625	22,035	26,708
Personnel cost	2,095	2,268	2,462
Fuel cost	2,605	3,079	5,190
Depreciation cost	14,280	17,267	21,127
Total	37,605	44,649	55,487

2) Feeder bus service

Table 12-3-14 Operating Expense

(Unit: M$ in thousand)

Item	1997	2001	2005
Maintenance cost	4,257	5,214	6,171
Personnel cost	23,830	28,202	32,431
Fuel cost	3,311	4,055	4,800
Depreciation cost	7,362	8,538	9,669
Total	38,760	46,009	53,071

12-4 Revenue Elements in Cash Flow Calculation

This paragraph deals with the revenue elements in the cash flow calculation. In case of Railway Service, the incremental operating revenue is calculated by applying unit fare (per passenger-km) to the incremental traffic (passenger-km). In case of Feeder Bus Service, operating revenue is calculated by applying unit fare (per person) to the incremental traffic (person).

12-4-1 Passenger Fare

(1) Railway service

Passenger fare per passenger-km according to MRA data is shown in Table 12-4-1.

Table 12-4-1 Railway Passenger Fare

(Unit: M$/passenger-km)

Passenger fare	0.044

(2) Feeder bus service

Passenger fare per person which is based on present Stage-Bus fare structure is shown in Table 12-4-2.

Table 12-4-2 Feeder-Bus Passenger Fare

(Unit: M$/person)

Passenger fare	0.30

12-4-2 Diverted Traffic Volume

As a result of the project completion, there will be traffic diverted from other mode (Stage-Bus).

The traffic volume of the diverted passengers are estimated by the demand forecast considering the transport capacity.

(1) Railway service

The diverted traffic volume is shown in the Table 12-4-3.

Table 12-4-3 Diverted Traffic Volume (Railway)

(Unit: 1000 passenger-km)

Item \ Year	1997	2001	2005
Passenger-km	894,980	1,165,263	1,435,545

(2) Feeder bus service

The diverted traffic volume is shown in the Table 12-4-4.

Table 12-4-4 Diverted Traffic Volume (Feeder-Bus)

(Unit: 1000 person)

Item \ Year	1997	2001	2005
Person	132,085	158,445	184,805

12-4-3 Result (Increase in operating revenue)

(1) Railway service

Increase in operating revenue is estimated as shown below:

Table 12-4-5 Passenger Revenue Increase

(Unit: M$ in thousand)

Item \ Year	1997	2001	2005
Operating revenue	39,379	51,272	63,164

(2) Feeder bus service

Increase in operating revenue is estimated as shown below:

(Unit: M$ in thousand)

Item \ Year	1997	2001	2005
Operating revenue	39,626	47,534	55,442

12-5 Operating Profit

The incremental operating profit (incremental operating revenue - incremental operating expense) is as shown in the Tables below:

Railway Service

Table 12-5-1 Operating Profit (Railway)

(Unit: M$ in thousand)

Item \ Year	1997	2001	2005
Operating revenue	39,379	51,272	63,164
Operating expense	37,605	44,648	55,487
Operating profit	1,774	6,624	7,677

Feeder Bus Service

Table 12-5-2 Operating Profit (Feeder-Bus)

(Unit: M$ in thousand)

Item \ Year	1997	2001	2005
Operating revenue	39,626	47,534	55,442
Operating expense	38,759	46,009	53,071
Operating profit	867	1,525	2,371

Railway & Feeder Bus Service

Table 12-5-3 Operating Profit (Railsay & Feeder-Bus)

(Unit: M$ in thousand)

Item \ Year	1997	2001	2005
Operating revenue	79,005	98,805	118,605
Operating expense	76,364	90,658	108,558
Operating profit	2,641	8,147	10,047

12-6 Minimum Ridership

"The minimum ridership of RBCS" is a railway traffic volume which will yield a fare revenue to offset operating and depreciation costs of railway and feeder-bus. It varies each year, as shown in Table 12-6-1. The diverted traffic will exceed it in 1999. The calculation is made as shown in Note.

Note: 1) The minimum ridership R as of 1997 is set up in terms of passenger-km.
Then, the number of feeder-bus passengers is presented by the following equation;

$$R \times \frac{1}{14} \times 2 \times 0.865 = 0.124R \text{ (passengers)} \quad \ldots\ldots \text{(12-1)}$$

2) Consequently, the RBCS revenue is given as follows:
$0.044R + 0.124R \times 0.30 = 0.0812R$ (M$)

3) Railway traffic demand in 1997:
3,013 thousand passenger-km/day

4) Number of railway trips in 1997:
215 thousand passenger trips/day

5) Average trip distance of railway user:
14 km (3,013 ÷ 215 = 14)

6) Ratio of feeder bus users against railway users: 86.5% (See 8-4-2, Table 8-4-1).

7) Total annual expense of railway and feeder-bus MS$76.364 million/year as shown in Table 12-5-3.
Hence, 0.0812R = M$ 76.364 million/year
R = 940.443 million passenger-km/year

8) As a result of the calculation, "the minimum railway ridership" in 1997 turns out to be 940.443 million passenger-km/year (or 184 thousand trips/day).
From equation (12-1), the minimum ridership of feeder-bus becomes 116.615 million persons/year.

9) In 1997, diverted traffic volume of railway is 894.980 million passenger-km/year and diverted traffic volume of feeder bus is 132.085 million persons as shown in Table 12-4-3 and 12-4-4.

10) Diverted traffic volume of railway in 1997 is less than 940.443 million passenger-km/year.
In 1999, it exceeds minimum ridership as shown in Table 12-6-1.

Table 12-6-1 Minimum Ridership

(Unit: M$ and passenger-km in million)

Item \ Year	1997	1998	1999
Total Expenses (M$)	76.364	78.220	80.262
Diverted traffic volume (passenger-km)	894.980	962.551	1,030.121
Minimum Ridership (passenger-km)	940.443	963.300	988.448

12-7 Cash Flow Analysis

12-7-1 Cash Flow and FIRR

Based on the method (12-1-2), premises (12-1-3) and cost/ revenues obtained in the preceding paragraphs, the cash flow and FIRR of the projects were calculated.

(1) Summary of cash flow

The fund raising plan and terms and conditions are shown in the Table 12-3-3.

The cash flow and net cash flow is worked out as shown in the computer output. (See Appendix 12-7-1, 12-7-2 and 12-7-3)

It can be summarized as in Table 12-7-1, 12-7-2 and 12-7-3.

1) Railway service

Table 12-7-1 Summary of Cash Flow (Railway)

(Unit: M$ in thousand)

Item \ Year	1997	2001	2005
Operating revenue	39,379	51,272	63,164
Operating expense	37,605	44,648	55,487
Maintenance cost	18,625	22,035	26,708
Personnel cost	2,095	2,268	2,462
Fuel cost	2,605	3,079	5,190
Depreciation	14,280	17,267	21,127
Operating profit	1,774	6,623	7,677
Investment	0	3,765	0
Cash flow	16,055	20,125	28,804
Borrowing	0	3,765	0
Loan repayment	0	55,469	65,956
Interest payment	31,062	32,498	21,192
Net cash flow (Cumulative NCF)	▲15,008 (▲15,008)	▲64,077 (▲170,569)	▲58,344 (▲397,935)
Net profit	▲29,288	▲25,875	▲13,515

Note: Figures ▲ mean deficit value.
NCF means net cash flow.

2) Feeder bus service

Table 12-7-2 Summary of Cash Flow (Feeder-Bus)

(Unit: M$ in thousand)

Item \ Year	1997	2001	2005
Operating revenue	39,626	47,534	55,442
Operating expense	38,759	46,009	53,071
Maintenance cost	4,257	5,214	6,171
Personnel cost	23,830	28,202	32,431
Fuel cost	3,311	4,055	4,800
Depreciation	7,362	8,538	9,669
Operating profit	866	1,524	2,371
Investment	60,550	3,390	3,330
Cash flow	Δ52,322	6,672	8,710
Borrowing	60,550	3,390	3,190
Loan repayment	0	8,650	10,587
Interest payment	4,844	5,929	3,986
Net cash flow (Cumulative NCF)	3,384 (3,384)	Δ4,516 (10,144)	Δ2,673 (Δ31,363)
Net profit	Δ3,978	Δ4,405	Δ1,615

Note: Figures Δ mean deficit value.
NCF means net cash flow.

3) Railway & feeder bus services

Table 12-7-3 Summary of Cash Flow (Railway & Feeder-Bus)

(Unit: M$ in thousand)

Item \ Year	1997	2001	2005
Operating revenue	79,005	98,805	118,605
Operating expense	76,364	90,658	108,558
Maintenance cost	22,882	27,249	32,879
Personnel cost	25,925	30,470	34,893
Fuel cost	5,916	7,134	9,990
Depreciation	21,642	25,805	30,796
Operating profit	2,641	8,147	10,047
Investment	60,550	7,155	3,330
Cash flow	▲36,267	26,797	37,513
Borrowing	60,550	7,155	3,190
Loan repayment	0	64,119	76,544
Interest payment	35,906	38,427	25,177
Net cash flow (Cumulative NCF)	▲11,624 (▲11,624)	▲68,593 (▲160,424)	▲61,018 (▲429,299)
Net profit	▲33,265	▲30,280	▲15,130

Note: Figures ▲ mean deficit value.
NCF means net cash flow.

(2) Result of cash flow analysis

1) Railway service

After the inauguration, the cash flow shows deficit in 2000, 2004 and 2017.

The deficit in 2000 and 2004, is caused by investment in DMU and as for 2017, it is caused by reinvestment in civil work and signalling & telecommunication.

As for the net cash flow, it becomes positive from 2010. However, it shows a deficit in 2017 again due to reinvestment in the above mentioned items.

As for the cumulative net cash flow, it shows a deficit during the project life.

Maximum amounts of main items and the years they take place are shown below.

(Unit: M$ in Million)

	Amount	Year
Operating profit	15	2004
Operating revenue	63	2005
Operating expense	55	2005
Loan balance	409	1999

2) Feeder bus service

After the inauguration, the cash flow shows deficit in 1997, 2003, 2009, 2015 and 2021.

As for 1997, it is caused by initial investment and as for other years, it is caused by reinvestment.

As for the net cash flow, it shows a deficit from 2001 to 2007, in 2009, 2015 and 2021.

It is due to repayment and reinvestment.

As for the cumulative net cash flow, it shows a deficit from 2003 to the end of project life.

Maximum amounts of main items and the years they take place are shown below.

(Unit: M$ in Million)

	Amount	Year
Operating profit	2.4	2005
Operating revenue	55.4	2005
Operating expense	53.1	2005
Loan balance	70.7	2000

3) Railway & feeder bus services

After the inauguration, the cash flow shows deficit in 1997, 2000, 2004, 2009 and 2021.

As for 1997, 2009 and 2021, it is caused by investment and reinvestment in bus.

As for 2000 and 2004, it is caused by investment in DMU.
As for the net cash flow, it becomes positive from 2008. However, it shows deficit in 2009 and 2021 due to reinvestment in bus.
As for the cumulative net cash flow it shows a deficit during the project life.
Maximum amounts of main items and the years they take place are shown below.

(Unit: M$ in Million)

	Amount	Year
Operating profit	17	2004
Operating revenue	119	2005
Operating expense	109	2005
Loan balance	476	1999

4) Result of cash flow analysis
The reason why the cash flow and the net cash flow shows a deficit after the inauguration, is considered as follows;

a) As for the cash flow, investment in bus is same year as the inauguration and investment amount in DMU is big comparatively.

b) As for the net cash flow, reinvestment is not financed and the terms and conditions of loan is too hard.

c) The base case of this project does not prove a high financial feasibility.

5) FIRR
In terms of discounted cash flow technique, FIRR worked out by computer model and FIRR is as shown in the Table 12-7-4. (See Appendix 12-7-1, 12-7-2 and 12-7-3).

Table 12-7-4 FIRR (Base Case)

Project	FIRR (%)
Railway Service	2.54
Feeder Bus Service	5.21
Railway & Feeder Bus Services	2.84

12-7-2 Sensitivity Analysis

Sensitivity analysis was conducted from pessimistic and optimistic point of view.

The result is shown in Table 12-7-5.

Table 12-7-5 Result of Sensitivity analysis

Case \ FIRR	Railway FIRR	Feeder Bus FIRR	Railway & Feeder Bus FIRR
10% Cost overrun	0.99%	0.46%	0.95%
10% Revenue reduction	0.59%	∆8.60%	∆0.48%
20% Fare increment	5.95%	30.87%	8.36%
20% Ridership increment	3.51%	5.21%	3.70%

Note: Due to 20% of ridership increment, as for Railway, investment cost of DMU, fuel, maintenance and depreciation costs of DMU are increased by 20 %. As for feeder bus, investment costs of bus and mini bus, maintenance, personnel, fuel and depreciation costs are increased by 20%.

12-8 Evaluation

FIRR: 2.84% of the base case indicates a low potentiality of the project

As the rate of return is less than 8% (which is evaluated as the prevailing interest rate of loan in Malaysia), the project is evaluated as financially non-feasible for the privatized MRA.

As for the cash flow and net cash flow, investment amount is comparatively large and reinvestment is not financed and terms and conditions of loan are too hard.

Hence, in order to make the project financially viable, raise of fare level and other Governmental measures have to be taken. Alternative 1 and 2 are proposed.

12-9 Alternatives

12-9-1 Alternative 1

(1) Raise of railway fare level

Railway fare level is raised to the same level of stage-bus fare shown in Table 12-9-1.

Table 12-9-1 Raise of Railway Fare Level

(Unit: M$)

Case / Item	Base case	Alternative 1
Fare level	0.044x	0.044x + 0.155y

Note: x : passenger-km
y : number of passenger

(2) Raise of feeder bus fare level

Feeder bus fare level is raised from M$0.30 to M$0.35. This would be justifiable because current feeder bus fare ranges from M$0.30 to M$0.50.

Table 12-9-2 Raise of Feeder Bus Fare Level

(Unit: M$)

Item \ Case	Base case	Alternative 1
Fare level	0.30	0.35

(3) Result of cash flow analysis

The cash flow and net cash flow are worked out as shown in the computer out put. (See Appendix 12-9-1, 12-9-2 and 12-9-3). It can be summarized as in Table 12-9-3.

Table 12-9-3 Summary of Cash Flow of Alternative 1

(Unit: M$ in thousand)

Item \ Year	1997	2001	2005
Operating revenue	95,170	118,679	142,188
Railway	48,940	63,223	77,506
Feeder Bus	46,230	55,456	64,682
Operating expense	76,364	90,658	108,558
Railway	37,605	44,648	55,487
Maintenance cost	18,625	22,035	26,708
Personnel cost	2,095	2,268	2,462
Fuel cost	2,605	3,079	5,190
Depreciation	14,280	17,267	21,127
Feeder Bus	38,759	46,009	53,071
Maintenance cost	4,257	5,214	6,171
Personnel cost	23,830	28,202	32,431
Fuel cost	3,311	4,055	4,800
Depreciation	7,362	8,538	9,669
Operating profit	18,806	28,021	33,630
Railway	11,335	18,575	22,019
Feeder Bus	7,471	9,446	11,611
Investment	60,550	7,155	3,330
Railway	0	3,765	0
Feeder Bus	60,550	3,390	3,330
Cash flow	▲20,102	46,671	61,096
Borrowing	60,550	7,155	3,190
Loan repayment	0	64,119	76,544
Interest payment	35,906	38,427	25,177
Net cash flow (Cumulative NCF)	4,542 (4,542)	▲48,720 (▲70,326)	▲37,436 (▲250,435)
Net profit	▲17,100	▲10,406	8,453

Note: Figures ▲ mean deficit value.
NCF means net cash flow.

After the inauguration, the cash flow shows a deficit in 1997 for investment in bus, in 2000 and 2004 for investment in DMU.

As for the net cash flow, it shows a deficit from 2000 to 2009 except 2007 and 2008.

The reasons are repayment of loan and reinvestment not financed.

Maximum deficit amount of cumulative net cash flow is M$ 283,007 in thousand in 2009.

The net cash flow and cumulative net cash flow become positive from 2010 and from 2016 respectively.

Maximum loan balance is M$ 476,088 in thousand in 1999.

As for the net cash flow, the most important thing is to get loan from bank, of which terms and conditions are softer.

(4) FIRR

In terms of discounted cash flow technique, FIRR of Alternative 1 works out by computer model and FIRR is as shown in Table 12-9-4 (See Appendix 12-9-1, 12-9-2 and 12-9-3).

Table 12-9-4 FIRR of Alternative 1

(Unit: percent)

Project \ Case	Base case	Alternative 1
Railway service	2.54	6.42
Feeder bus service	5.21	26.38
Railway & feeder bus services	2.84	8.37

(5) Sensitivity analysis

Sensitivity analysis of Alternative 1 was conducted and the result is as shown in Table 12-9-5.

Table 12-9-5 Sensitivity Analysis of Alternative 1

(Unit: percent)

Case	FIRR
Base case (Alternative 1)	8.37
10% cost overrun	6.46
10% Revenue reduction	5.18
20% Ridership increment	9.32

(6) Evaluation

FIRR: 8.37% is more than 8% (which is the prevailing interest rate of loan in Malaysia) and Alternative 1 is considered as financially viable.

12-9-2 Alternative 2

(1) Governmental subsidy;
Government subsidizes for the initial investment cost (in 1995 and 1996) of the ground facilities, 30% of the DMU (in 1996) and the engineering and consultant fee.

(2) Tax exemption;
Government detaxes the custom duty and sales tax of initial investment cost for DMU.

(3) Amount of subsidy and tax exemption;
Amount of subsidy and tax exemption are as follows;

Amount of subsidy and tax exemption;

(Unit: M$ in Million)

1) Initial investment cost (in 1995 and 1996)	119
2) 30% of initial investment cost (in 1996) for DMU	61
3) Engineering & consultant fee (in 1993 and 1994)	7
4) Tax exemption for initial investment of DMU (in 1996)	31
Total	218

(4) Result of cash flow analysis
The cash flow and net cash flow are worked out as shown in the computer output. (See Appendix 12-9-4, 12-7-2 and 12-9-5)

It can be summarized as in Table 12-9-6.

Table 12-9-6 Summary of Cash Flow of Alternative 2

(Unit: M$ in thousand)

Item \ Year	1997	2001	2005
Operating revenue	79,005	98,805	118,605
Railway	39,379	51,272	63,164
Feeder Bus	39,626	47,534	55,442
Operating expense	67,812	82,106	100,006
Railway	29,053	36,096	46,935
Maintenance cost	18,625	22,035	26,708
Personnel cost	2,095	2,268	2,462
Fuel cost	2,605	3,079	5,190
Depreciation	5,728	8,714	12,575
Feeder Bus	38,759	46,009	53,071
Maintenance cost	4,257	5,214	6,171
Personnel cost	23,830	28,202	32,431
Fuel cost	3,311	4,055	4,800
Depreciation	7,362	8,538	9,669
Operating profit	11,193	16,699	18,600
Railway	10,326	15,175	16,229
Feeder Bus	866	1,524	2,371
Investment	60,550	7,155	3,330
Railway	0	3,765	0
Feeder Bus	60,550	3,390	3,330
Cash flow	△36,267	26,797	37,513
Borrowing	60,550	7,155	3,190
Loan repayment	0	30,336	42,761
Interest payment	16,988	22,211	19,772
Net cash flow	7,295	△18,595	△21,830
(Cumulative NCF)	(7,295)	(△969)	(△96,876)
Net profit	△5,795	△5,512	△1,172

Note: Figures △ mean deficit value.
NCF means net cash flow.

After the inauguration, cash flow shows a deficit in 1997 for investment in bus, in 2000 and 2004 for investment in DMU, in 2009 and 2021 for reinvestment in bus.

As for the net cash flow, it shows a deficit from 2000 to 2009 except 2008.

The reasons are repayment of loan and reinvestment not financed.

The cumulative net cash flow become positive from 2019.

Maximum deficit amount of cumulative net cash flow is M$ 187,291 in thousand in 2009.

Maximum loan balance is M$ 270,485 in thousand in 2000.

(5) FIRR

FIRR of Alternative 2 works out by computer model and each FIRR is as shown in the Table 12-9-7. (See Appendix 12-9-4, 12-7-2 and 12-9-5.)

Table 12-9-7 FIRR of Alternative 2

(Unit: percent)

Case / Project	Base case	Alternative 2
Railway service	2.54	9.06
Feeder bus service	5.21	5.21
Railway & feeder bus services	2.84	8.33

(6) Sensitivity analysis

Sensitivity analysis of Alternative 2 was conducted and the result is as shown in Table 12-9-8.

Table 12-9-8 Sensitivity Analysis of Alternative 2

(Unit: percent)

Case	FIRR
Base case (Alternative 2)	8.33
10% Cost overrun	5.33
10% Revenue reduction	3.08
20% Ridership increment	10.55

(7) Evaluation

FIRR: 8.33% is more than 8% and Alternative 2 is considered as financially viable.

12-9-3 Alternative 3

An additional analysis was conducted on the request of the Malaysian side.
The new conditions and the study results are as follows;

(1) Alternative 3-A

1) New conditions:

a) The DMU/feeder-bus fares are the same as in the case of Alternative 1.

b) The investment and re-investment costs for railway ground facilities (excepting the ticket - vending machine and DMU maintenance plant/machinery) are borne by the Government during the whole project life.

c) MRA is exempted from import tax for DMU's and other imported materials.

2) The study result:

a) The subsidy and tax exemption in the above mentioned case will amount to:

(Unit: M$ in Million)

i)	Initial investment cost	114
ii)	Tax exemption	57
	Total	171

b) The cash flow and net cash flow are worked out as shown in the computer output. (See Appendix 12-9-6, 12-9-2 and 12-9-7.)

It can be summarized as in Table 12-9-9.

Table 12-9-9 Summary of Cash Flow of Alternative 3-A

(Unit: M$ in thousand)

Item \ Year	1997	2001	2005
Operating revenue	95,170	118,679	142,188
Railway Feeder Bus	48,940 46,230	63,223 55,456	77,506 64,682
Operating expense	70,650	84,357	101,707
Railway	31,891	38,347	48,636
Maintenance cost Personnel cost Fuel cost Depreciation Feeder Bus	18,625 2,095 2,605 8,567 38,759	22,035 2,268 3,079 10,966 46,009	26,708 2,462 5,190 14,275 53,071
Maintenance cost Personnel cost Fuel cost Depreciation	4,257 23,830 3,311 7,362	5,214 28,202 4,055 8,538	6,171 32,431 4,800 9,669
Operating profit	24,520	34,322	40,481
Railway Feeder Bus	17,049 7,471	24,876 9,446	28,870 11,611
Investment	60,550	4,308	3,330
Railway Feeder Bus	0 60,550	918 3,390	0 3,330
Cash flow	▲20,102	49,518	61,096
Borrowing	60,550	4,308	3,330
Loan repayment	0	41,719	52,028
Interest payment	23,362	26,490	21,906
Net cash flow (Cumulative NCF)	17,086 (17,086)	▲14,383 (38,280)	▲9,508 (5,699)
Net profit	1,158	7,832	18,575

Note: Figures ▲ mean deficit value.
NCF means net cash flow.

Alter the inauguration, cash from shows a deficit in 1997 due to large investment in bus and in 2004 due to investment in DMU.

As for the net cash flow, it shows a deficit from 2000 to 2009 except in 2007 and 2008.

However, the cumulative net cash flow shows positive during the project life except in 2006.

c) FIRR

FIRR of Alternative 3-A works out by computer model and each FIRR is as shown in the Table 12-9-10. (See Appendix 12-9-6, 12-9-2 and 12-9-7.)

Table 12-9-10 FIRR of Alternative 3-A

(Unit: percent)

Case / Project	Base case	Alternative 3-A
Railway service	2.54	12.27
Feeder bus service	5.21	26.38
Railway & feeder bus services	2.84	14.16

d) Evaluation

FIRR of 14.16% is more than 8%, so Alternative 3-A is considered financially viable.

(2) Alternative 3-B

1) New conditions:

a) The feeder bus fare level is as in the case of Alternative 3-A.

b) The investment and re-investment costs are borne by the Government, the same as in Alternative 3-A.

c) MRA is exempted from import tax as in Alternative 3-A.

d) The DMU fare level would be adjusted to bring about the FIRR value nearest to that of Alternative 1, namely, approximately 8.37%.

2) The study result:
Under the above-mentioned conditions, the DMU fare level could be reduced by 24.4%, compared with the fare level of the Alternative 1.
Refer to Table 12-9-11.
(See Appendix 12-9-8, 12-9-2 and 12-9-9.)

Table 12-9-11 FIRR of Alternative 3-B

(Unit: percent)

Project \ Case	Base case	Alternative 3-B
Railway service	2.54	5.12
Feeder bus service	5.21	26.38
Railway & feeder bus services	2.84	8.37

Chapter 13

LAND-USE PLANNING

Chapter 13 LAND-USE PLANNING

13-1 Introduction

13-1-1 Items Studied

The Malaysian Government requested three issues to be studied in addition to the original Scope of Work. There are:

(1) Conduct case studies on the impacts of RBCS on land-use of selected station areas along the Corridor.

(2) Propose alternative development actions and planning measures based on the above-mentioned study.

(3) Prepare reference materials on urban planning policies and strategies related to commuter train networks in Japan.

This chapter covers the 1st and 2nd of the above mentioned issues. As to the 3rd, data have been handed over to the Malaysian counterparts through EPU, separately from the reports. A list of the provided data, with brief explanations, is given in Appendix 13-1-1.

13-1-2 Study Principles

Current regional/urban development plans related to the RBCS Corridor had been established before the DTP/RBCS projects were decided. RBCS is planned in order to encourage the achievement of these development plans. The introduction of RBCS will, however, change the person-trip patterns of the Corridor and this change in person- trip patterns will exert impacts to the land-use of the areas along the Corridor.

The discussion between the Team and KVPS counterparts led to the following study principles:

(1) Regional/urban development plans related to the RBCS Corridor which have been so far established should be the basis for formulating the development scenario of the land-use plans around the stations.

(2) Alternative development actions should therefore be primarily based on these scenarios and they should be justifiable based on the RBCS impacts correctly foreseen.

13-2 Review of RBCS Corridor on Current Development Plans

In observance of the study principle (1) above, the so far established development policies/strategies were reviewed and confirmed (13-2-1(1) and (2)). The Corridor was partitioned to identify the characteristics and problems (13-2-2). Then, the Corridor was reviewed on the population/employment distribution (1993/2005) and the planned land-use (2000) according to the prepared partitions (13-2-3(1) and (2)).

13-2-1 Review on the Current Development Policies/Strategies

(1) Regional development policy/strategy:

The Review features a dispersal concept for the development of this area (i.e. development should be well balanced throughout the Klang Valley). Namely;

- The development should not be structured with one centre at K.L., but it should be structured with multi-centers in the six Major Growth Centres.
- The expansion of K.L. Conurbation should be kept within a circle of 10-15km radius (within the Green Belt-Buffer Zone). The Major Growth Centres outside the K.L. Conurbation should be "self-contained", with their functions of administrative/commercial centres.
- The urban development should be two-directioned; K.L. - Rawang/Kuang and K.L. - Bangi (Major Growth

Directions, 1985-2000).

(2) Current regional setting on the Corridor:
The Review identifies the cores of the Corridor-area as follows;

a. K.L. Conurbation as a circle of 10-15 km radius which includes;

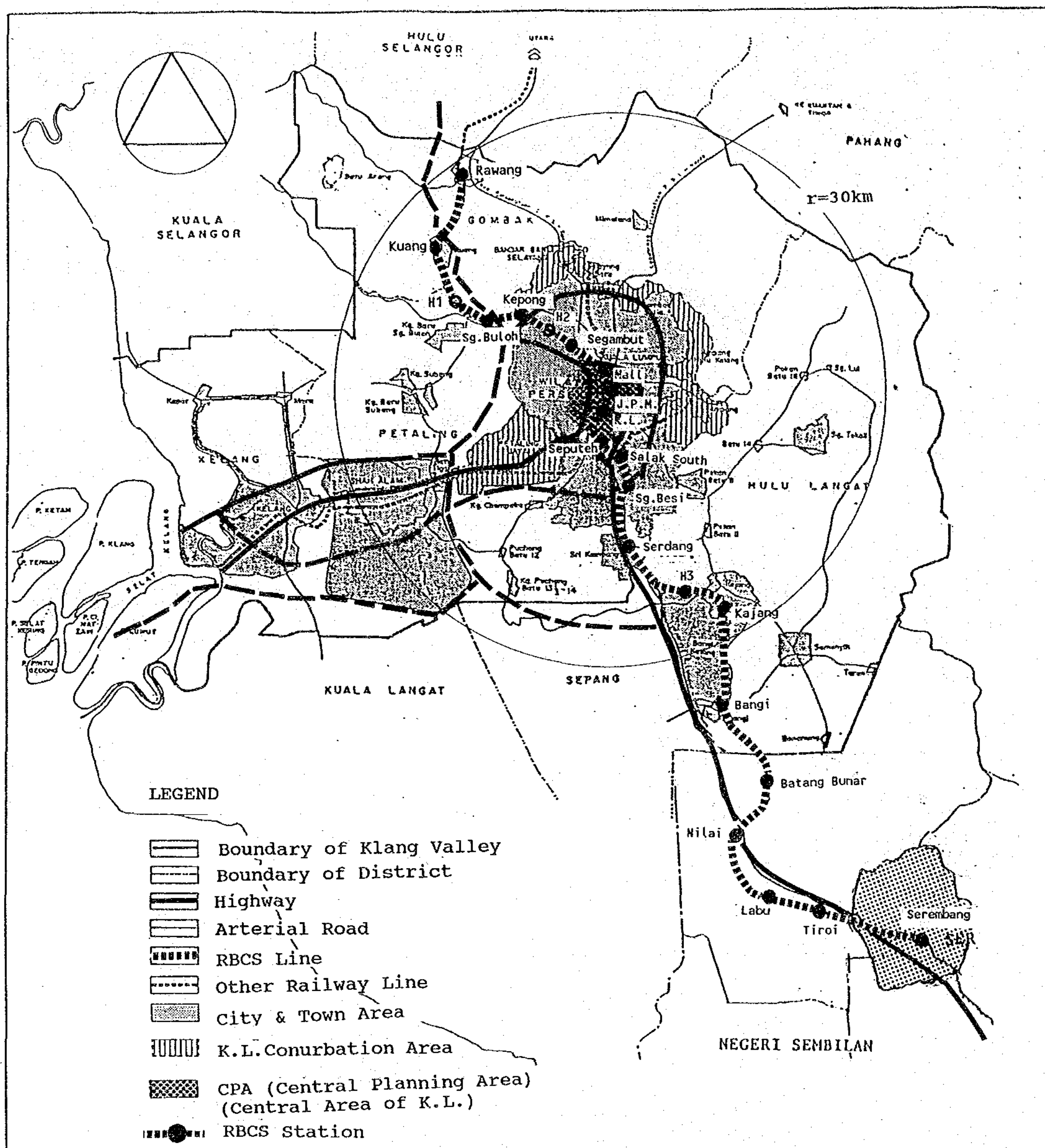
- Central Planning Area (CPA), the city centre of K.L. (a circle of 2.0-2.5 km radius) as determined in K.L. Structure Plan
- Other areas surrounding CPA

b. Bangi New Town as a Major Growth Centre in the Southern Suburbs

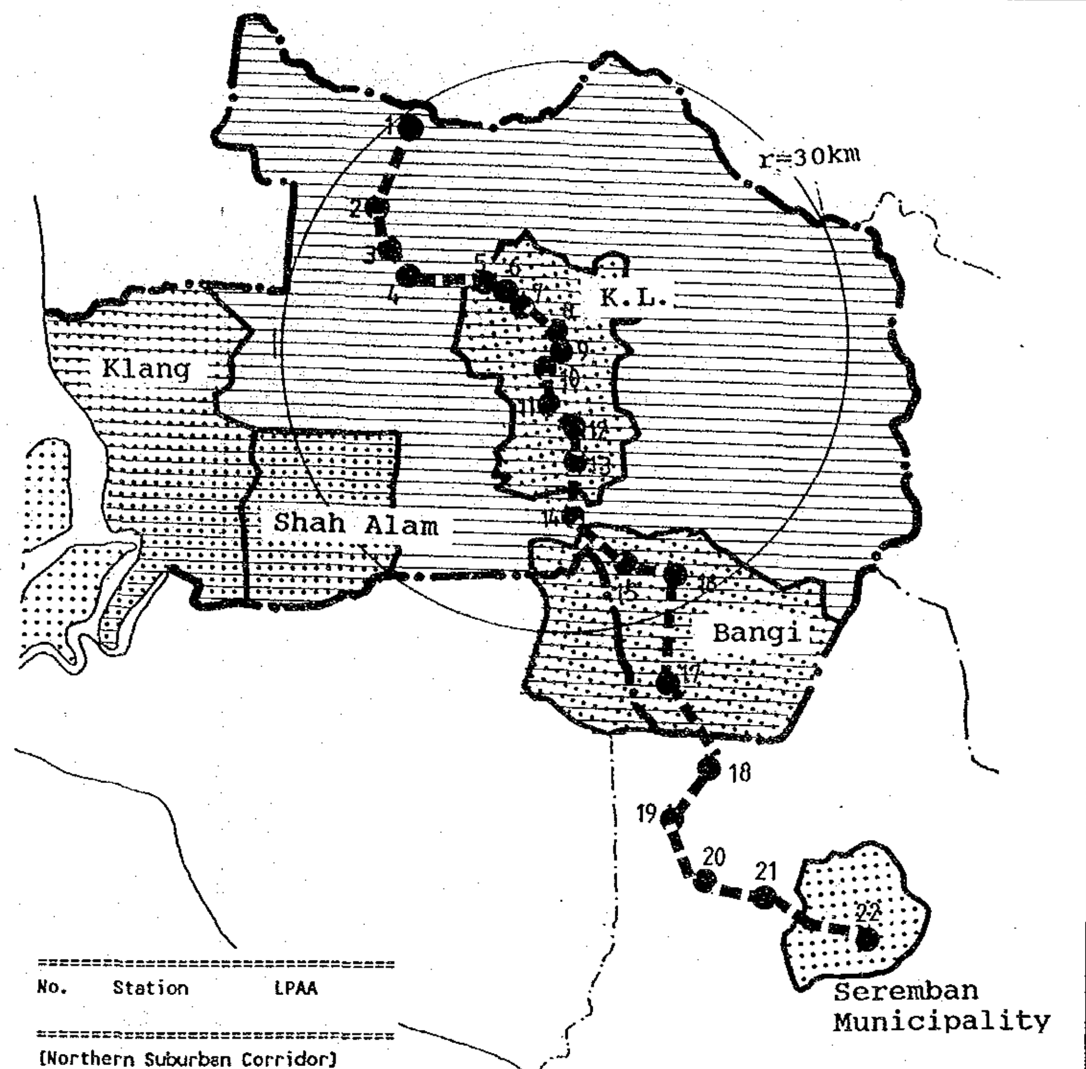
c. Three satellite towns; Rawang, Kuang and Sg. Buloh in the Northern Suburbs

d. Seremban Municipality as a major city

Fig. 13-2-1 and Table 13-2-1 shows the areas and the relevant RBCS stations.



(1) Urban Area, Highway and the Corridor



No.	Station	LPAA
[Northern Suburban Corridor]		
1	Rawang	
2	Kuang	
3	H1	
4	Sg.Buloh	
[Northern Intermediate Corridor]		
5	Kepong	LPAA
6	H2	LPAA
7	Segambut	LPAA
[Central Area]		
8	Mall	LPAA
9	J.P.M.	LPAA
10	K.L.	LPAA
[Southern Intermediate Corridor]		
11	Seputeh	LPAA
12	Salak South	LPAA
13	Sg.Besi	LPAA
14	Serdang	
[Southern Suburban Corridor]		
15	H3	LPAA
16	Kajang	LPAA
17	Bangi	LPAA
[Southern Rural Corridor]		
18	Batang Bunar	
19	Nilai	
20	Labu	
21	Tiroi	
[Seremban Urban Area]		
22	Serembang	LPAA

(2) Planned Areas and the Corridor

Fig. 13-2-1 Location of the Corridor

Table 13-2-1 Planned Status on the Corridor (for 2000/2005)

-- in the Review and the Structure Plans --

Station Area	Planned Status: LPAA	Planned Status: Structure Plan	Centres/Towns Status and the Urban Hierarchy/Function for 2000/2005: Centre/Town planned in the Review of Perspective Plan	Urban Hierarchy planned in the Review of Perspective Plan	Urban Function planned in the Review of Perspective Plan (planned in the Structure Plans)
[Northern Suburban Corridor]					
1 Rawang		(B1)	Satellite Town	Satellite Centre	Local Administration/Commercial/Industrial Centre
2 Kuang		(B1)	Satellite Town	Satellite Centre	Local Administration/Commercial Centre
3 H1		(B3)	Satellite Town	Satellite Centre	Local Administration/Commercial/Light Industrial Centre
4 Sg.Buloh		(B3)	Satellite Town (C1)	Satellite Centre	Local Administration/Commercial/Light Industrial Centre
[Northern Intermediate Corridor]					
5 Kepong	LPAA	Approved (B2)	Major Growth Centre (C2)	(National Capital)	(D1)[Existing Development Area Edenburgh (E1) in a 2-km radius circle]
6 H2	LPAA	Approved (B2)	Major Growth Centre (C2)	(National Capital)	(D1)[Existing Development Area Jinjung (E1) in a 2-km radius circle]
7 Segambut	LPAA	Approved (B2)	Major Growth Centre (C2)	(National Capital)	(D1)
[Central Area]					
8 Mall	LPAA	Approved (B2)	Major Growth Centre (C2)	National Capital	D1 [Central Area/Central Planning Area (CPA) (E2)]
9 J.P.M.	LPAA	Approved (B2)	Major Growth Centre (C2)	National Capital	D1 [Central Area/Central Planning Area (CPA) (E2)]
10 K.L.	LPAA	Approved (B2)	Major Growth Centre (C2)	National Capital	D1 [Central Area/Central Planning Area (CPA) (E2)]
[Southern Intermediate Corridor]					
11 Seputeh	LPAA	Approved (B2)	Major Growth Centre (C2)	(National Capital)	(D1)[Existing Development Area Seputeh (E1) in a 2-km radius circle]
12 Salak South	LPAA	Approved (B2)	Major Growth Centre (C2)	(National Capital)	(D1)[New Growth Area Bandar Baru Tun Razak (E1)
13 Sg.Besi	LPAA	Approved (B2)	Major Growth Centre (C2)	(National Capital)	(D1) in a 2-km radius circle]
14 Serdang		(B3)			
[Southern Suburban Corridor]					
15 H3	LPAA	Approved (B4)	New Growth Centre (C3)	(District Centre)	(D2)
16 Kajang	LPAA	Approved (B4)	New Growth Centre (C3)	(District Centre)	(D2)[A Major Local Centre Kajang (E3) within a 1-km radius circle]
17 Bangi	LPAA	Approved (B4)	New Growth Centre (C3)	(District Centre)	(D2)
[Southern Rural Corridor]					
18 Batang Bunar		(B5)			
19 Nilai		(B5)			
20 Labu		(B5)			
21 Tiroi		(B5)			
[Seremban Urban Area]					
22 Serembang	LPAA	Approved (B6)		State Capital	[Administration/Commercial/Trade/Industrial Centre (E4)]

Note:

B1 Development Guideline (Gombak District Development Plan (Interim), 1986 KVPS)
B2 Kuala Lumpur Structure Plan, 1984
B3 under preparation (Petaling District Structure Plan)
B4 Bangi Structure Plan, 1987
B5 under prepareation (N.Sembilan State Master Plan)
B6 Seremban Structure Plan, 1986

C1 Sg.Buloh New Township.
C2 Federal Territory of K.L..
C3 Bangi/Kajang New Township.

D1 is the "National Adminstrarion/Commercial/Trade/Financial Centre" planned for Federal Territory of K.L..
D2 is the "District Administration/Industrial Centre" planned for the Bangi New Town

E1 is planned in the K.L. Structure Plan.
E2 are defined by the K.L.Structure Plan.
E3 is planned in the Bangi Structure Plan.
E4 is planned in the Seremban Structure Plan.

(3) Planning areas and blanks:

Major portions of the areas along the Corridor are already covered by the Local Planning Authority Areas (LPAA) which are authorized by the Structure Plans (Act 172, 1976 Town and County Planning Act). The relevant plans are K.L. Structure Plan, Bangi Structure Plan and Seremban Structure Plan, etc. as shown in Fig. 13-2-1. But the areas below mentioned have not yet been covered by LPAA.

- Northern suburban areas including Rawang-, Kuang, Sg. Buloh-Stations and H1.
- Southern rural areas in Seremban District including Batang Benar-, Nilai-, Labu- and Tiroi-stations
- A southern suburbs including Serdang Station

Note: The first and third areas above are not totally planning blanks, since the Review gives the future development framework and land-use guideline (2000).

(4) Transportation policy in the current development plans:
The Review and Structure Plans recognizes the expansion of the daily trip area of inhabitants and sets out a series of transportation policies to cope with this expansion.

1) Expansion of daily person-trip area;
The present daily person-trips of the inhabitants of K.L. and surrounding areas stay within a 10-15 km radius circle. With economic and demographic growths, this circle is estimated to expand to a 15-20 km radius circle, covering the satellite towns such as Rawang, Kuang and Sg.Buloh. It will further expand to another circle of 20-30 km radius circle which includes Bangi New Town. Thus expanded, the areas will form a future Metropolitan area.

2) Public transport policy in the current development plans;
To cope with this large scaled urbanization of the whole area in future, the Review and Bangi Structure Plan adopted a public transportation policy. It will introduce the rail-based mass transit systems in this region in addition to the conventional highway transport. To be noted among them is the Bangi Structure Plan which features;

- With the progressive expansion of the transportation systems, their integration and coordination will be phazed to maximize the potential benefits to the LPAA
- The proposed Metropolitan Light Rail Transit (LRT) system shall be extended to Bangi
- The Mass Rapid Transit (MRT) system shall be extended to Bangi by utilizing the rail-bus system proposed by MRA
- The Public transport utilization shall be optimized

The above-mentioned policy in the Bangi Structure Plan seems to be a different concept from the DTP/RBCS concept. But the two concepts should be developed into a combined/integrated transportation policy which can cover the whole area of New Town, as mentioned in 13-3-5(3).

13-2-2 Partition of the Corridor for Planning and Analysis:

Considering the current regional setting and the locations, a partition of the Corridor was made. It will do good for the problem identification. The Corridor is divided as follows;

(1) Sections within K.L. Conurbation

- Section corresponding to CPA (the Central Area of K.L.)
- Two sections other than above

(2) Sections outside the K.L. Conurbation

- Section corresponding to Northern Suburbs including three Satellite Towns
- Section corresponding to Southern Suburbs including Bangi, a new Major Growth Centre

(3) Sections outside Klang Valley

- Section corresponding to the urbanized Seremban Municipality
- Section corresponding to other rural areas of Seremban District

Refer to Table 13-2-1.

13-2-3 Review of Development Framework and Planned Land-Use along RBCS Corridor

(1) Population/employment distributions:

According to the above-mentioned partitions of the Corridor, Figure 13-2-2 and Table 13-2-2 show: the night-time population and day-time employment (for 2005) distributed among the traffic zones of the Corridor; and the population growth (1993-2005) (Refer to 3-3-2). The future values were estimated by using the current population/employment scenarios. Not to mention that the RBCS impacts were not considered.

Major characteristics of each section are as follows;

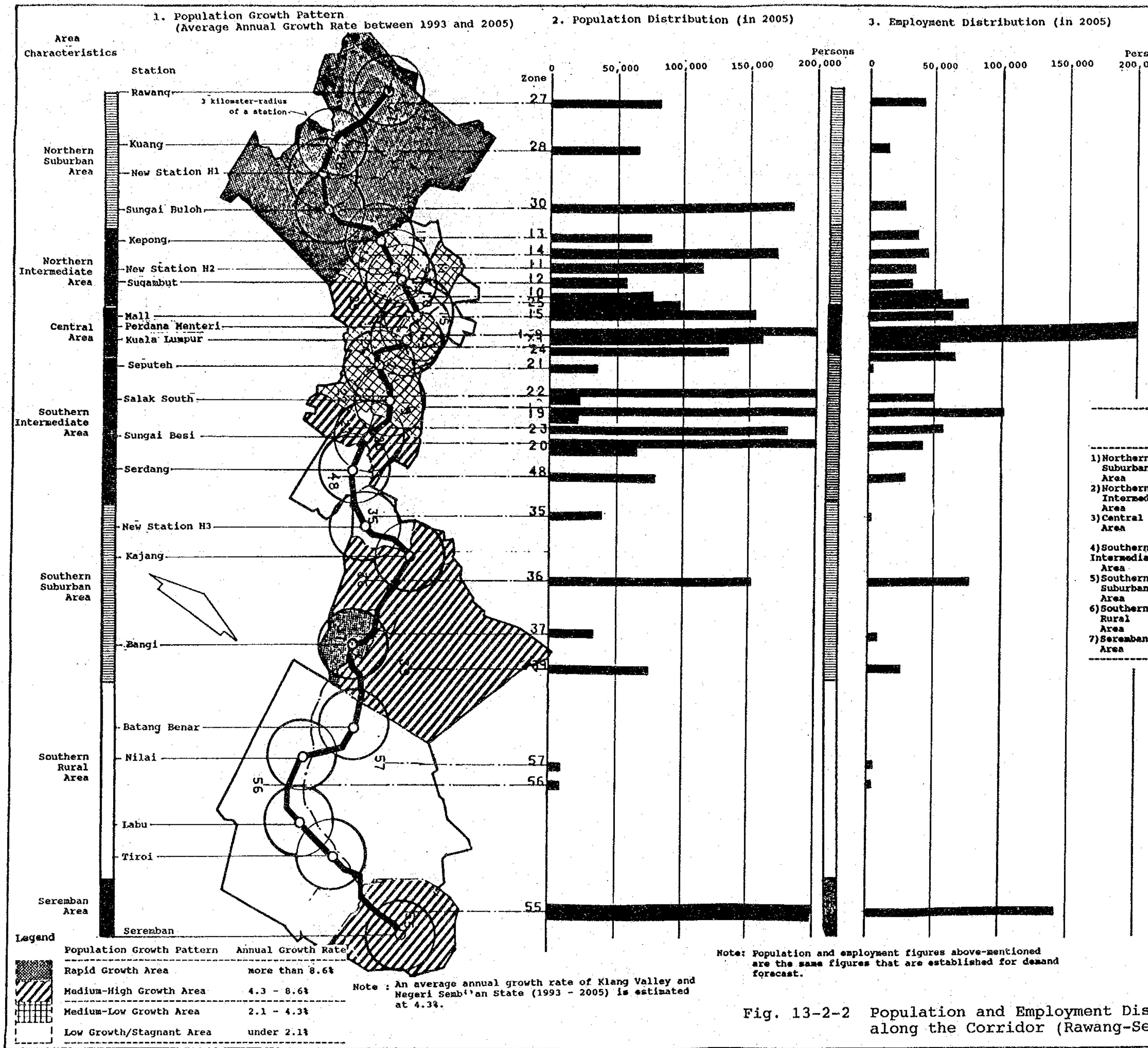
1) Northern Suburbs (with Rawang, Kuang, etc.);
The population will increase at an annual rate of 10% in the areas along this section (1993-2005), the highest of the Corridor. Population is small at present, medium-scaled in future.

2) Southern Suburbs (with Bangi New Town);
The population increase rate is also high along this section. It will exceed 250,000 in future. The area sees a comparatively large day-time employment.

3) Northern and Southern Intermediate Areas surrounding K.L. CPA;
The population/employment mass is heavy here. The future growth will also be large.

4) K.L. city centre;
The population as well as the employment mass (day-time) is the heaviest of the Corridor.

5) Seremban Municipality;
The population and employment are large in scale with a high rate of increase.



[Comment]

) Seven Areas of RBCS Corridor

1) Northern Suburban Area
(Rawang, Kuang, H1 and Sg.Buloh)
2) Northern Intermediate Area
(Kepong, H2 and Sugambut)
3) Central Area
(Mall, Perdana Menteri and KL.)
4) Southern Intermediate Area
(Seputeh, Salak South, Sg.Besi and Serdang)
5) Southern Suburban Area
(H3, Kajang and Bangi)
6) Southern Rural Area
(Batang Benar, Nilai, Labu and Tiroi)
7) Seremban Area
(Seremban)

2. Overview

	Population Growth (1993-2005)	Population planned for 2005	Employment planned for 2005
1) Northern Suburban Area	Rapid growth	Medium	Rather small
2) Northern Intermediate Area	Medium-low	Large	Rather small
3) Central Area	Medium-low	Largest	Largest
4) Southern Intermediate Area	Medium-low/ -high	Large	Large
5) Southern Suburban Area	Medium-high	Medium-large	Medium-large
6) Southern Rural Area	Stagnant	Small	Small
7) Seremban Area	Medium-high	Largest	Large

Fig. 13-2-2 Population and Employment Distribution along the Corridor (Rawang-Seremban) in 2005

Table 13-2-2 Population and Day-Time Employment Framework Relating to RBCS Corridor (1993/2005)

Traffic Zone *1	Stations included	Population 1993	Population 2005	Employment 1993	Employment 2005	Annual Growth Rate (1993/2005) Population	Annual Growth Rate (1993/2005) Employment
		(x1000)		(x1000)			(%)
[Northern Suburban Corridor]							
27	Rawang	20.1	82.7	11.7	44.6	12.49	11.76
28	Kuang/H1	5.0	61.3	3.9	10.8	23.32	8.77
30	H1/Sg.Buloh	59.3	185.8	14.3	22.4	9.99	3.80
[Northern Intermediate Corridor]							
13	Kepong/H2/Segambut	64.1	72.7	21.0	34.2	1.05	4.16
14	Kepong/H2	118.2	180.5	24.5	43.9	3.59	4.97
11	Segambut	76.8	106.1	17.5	33.0	2.73	5.44
12	Sugambut	43.1	60.6	18.3	31.1	2.88	4.52
10	Segambut/Mall	70.1	75.9	39.3	54.7	0.66	2.80
25	Mall/J.P.M./K.L.	55.7	99.0	40.4	78.1	4.91	5.64
15	Mall	137.0	154.5	41.7	61.6	1.01	3.30
[Central Area]="City Centre"							
1-9	Mall/J.P.M./K.L.	272.6	360.0	314.0	453.3	2.34	3.11
[Southern Intermediate Corridor]							
24	K.L./Seputeh	89.4	135.0	45.3	65.9	3.49	3.18
21	Seputeh	56.1	73.6	16.1	24.1	2.29	3.40
22	Salak South/Sg.Besi	152.7	223.6	31.7	48.3	3.23	3.56
19	Salak South	164.7	225.6	60.9	108.4	2.66	4.92
23	Sg.Besi	78.5	178.0	26.0	56.5	7.06	6.67
20	Salak South/Sg.Besi	139.5	264.2	27.4	39.6	5.47	3.12
[Southern Suburban Corridor]							
48	Serdang	61.5	76.2	20.7	27.3	1.80	2.35
35	Serdang/H3/Kajang	30.5	38.2	8.8	20.4	1.89	7.29
36	H3/Kajang	80.9	152.0	37.3	76.4	5.40	6.16
37	Bangi	11.4	32.9	6.4	7.3	9.22	1.07
[Southern Rural Corridor]							
57	Batang Benar/Nilai/Labu /Tiroi	9.8	9.3	2.9	4.2	-0.44	3.13
56	Nilai/Labu/Tiroi	9.9	9.4	2.9	4.2	-0.43	3.13
[Seremban City Area]							
55	Seremban	212.6	398.0	84.0	140.1	5.36	4.35

Note Above Figures were formulated for the demand forecast of this Study.

*1: These include the stations of the Corridor.

6) Rural areas in Seremban District;
The population and employment have stayed the same or slightly declined in 1980's in this section. There are no large development plans envisaged in the Negeri Sembilan Master Plan now being set up.

(2) Planned land-use along the Corridor:
The land-use planned (for 2000) in the Review is shown in Fig. 13-2-3 (5 km radius circles around each RBCS stations of the Corridor). The existing built-up areas (as of 1985) and the future development areas are also indicated. In the Intermediate Area and Suburbs, the areas within 3-km radius circles around each station are planned for housing, industrial development. They are also planned for institutional uses, such as schools, universities, research institutes, etc.

The areas can be divided into two groups according to the planned status;

Group 1 Areas with Structure Plans;
The relevant Structure Plans have determined the development policies for development frame, land-use, transportation and other sectors. The stations included in this group of areas; Kajang, Bangi, H3, Kepong, H2, Segambut and Salak South.

Group 2 Areas without Structure Plans;
The Review gives the guideline regarding the urban hierarchy, and functions the future population frame and land-use, etc.
The stations included in this group of areas;
Rawang, Kuang, H1, Sg.Buloh and Serdang.
To be noted is that, at Rawang and Kuang, the satellite towns are planned in the station areas.

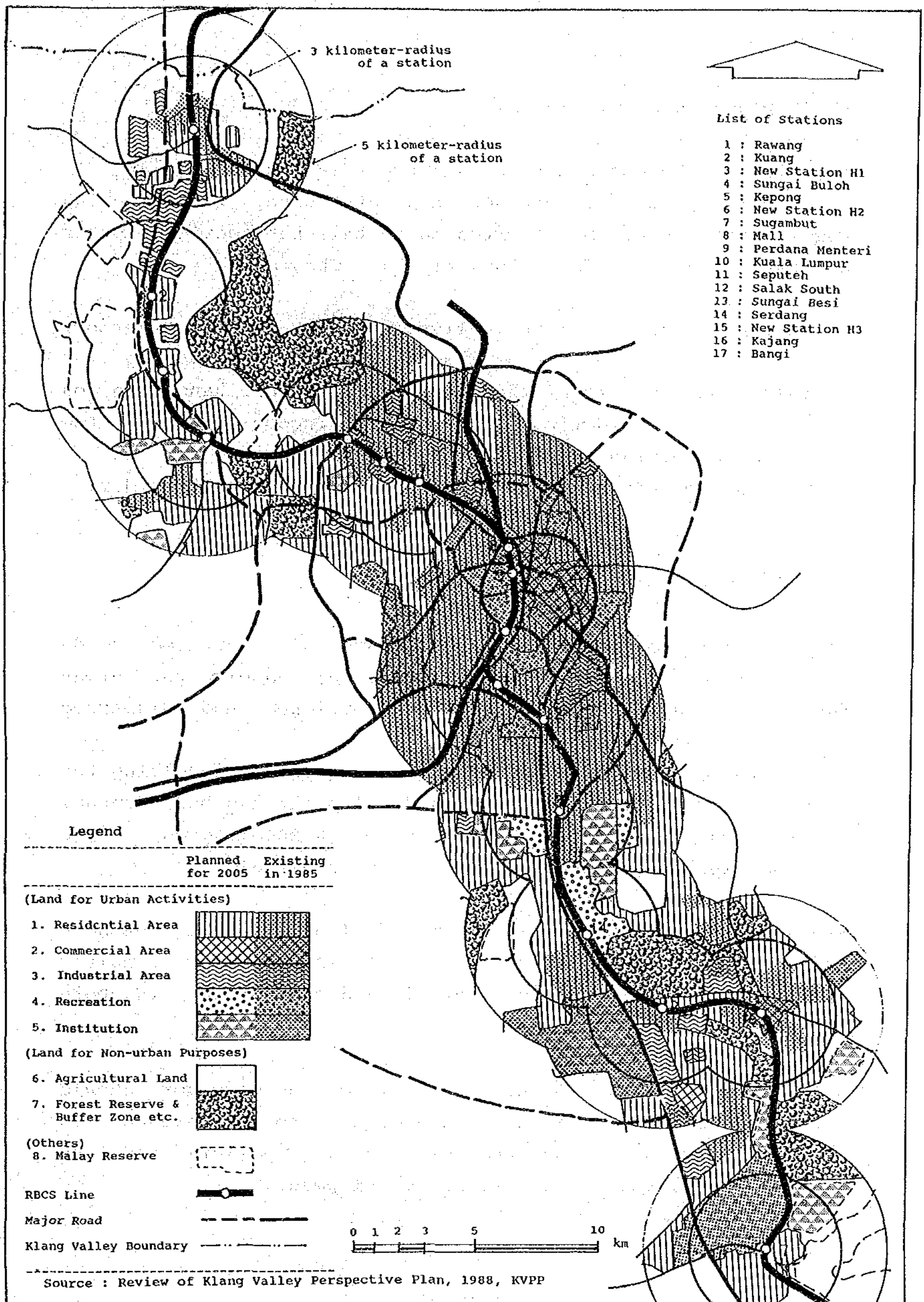


Fig. 13-2-3 Planned Land Use along the Corridor (Rawang-Bangi) for 2005